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The Maryland Fruit Grower

August, 1934

Maryland State
Horticultural Society

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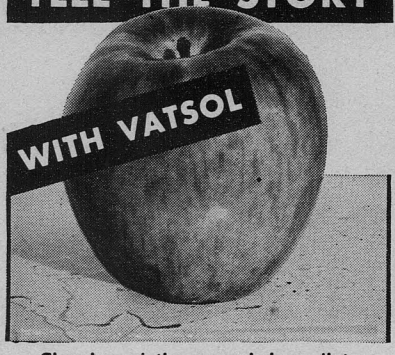
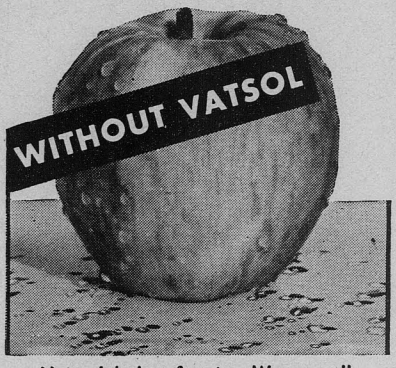


Cleaning solution comes in immediate and complete contact with surface of fruit. Spray residue quickly removed. Note unbroken washing film on fruit.



Note globules of water. Waxy or oil-lead sprayed surface not covered by cleaning solution—hence danger of spotty or incomplete residue removal.

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The Maryland Fruit Grower

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NITROGEN—FALL OR SPRING?

Investigators in Maryland and other states have been working on the question of fall versus spring application of nitrogen fertilizers. The results and conclusions have been so well summarized by Laurenz Greene of Purdue (Indiana) Experiment Station, and reported in the 1932 Transactions of the Indiana Horticultural Society, that it will be of value for every grower to read the discussion, no matter what his system of fertilizer treatment may be. The article follows:—

Fall and Spring Applications of Nitrate to Apple Trees

Spring applications of nitrogen to apple trees have produced such large increases in growth and yield that these applications are almost universally used in commercial orchards where trees are growing in sod or less fertile soils. Because nitrogen fertilizers applied early in the spring materially increase the percentage of blossoming spurs that set fruit, often an excess load of fruit is borne which weakens the tree. Such fruit must be severely thinned to prevent tree breakage and to permit the remaining fruit to attain marketable size. This heavier set of fruit on trees that tend to bear every other year has been observed to make the biennial bearing habit more pronounced. For this reason it has been recommended that for such varieties no nitrogen fertilizer be applied in the spring of the crop or "on" year, but that such applications be made in the fall before the crop year, thus preventing an excess setting of fruit. Spring applications have been recommended for the "off" year to promote growth and fruit bud formation. To illustrate, if a heavier crop of a particular variety is expected in 1933, the fertilizer would be applied in the fall of 1932 and no more applied until the spring of 1934 when a light crop would be expected and when it would be desirable to have as large a percentage of the blossoms set as possible. If fruit bud formation is abundant in 1934, another application would be made in the fall of '34 and none in the spring of '35. In other words, the theory is that nitrogen should be applied to biennial bearers in the spring and fall of the "off" year and none applied in the "on" year.

Apple trees bear a large percentage of their fruits on spur-like growths. Usually the individual spur bears fruit once in two years. It forms a fruit bud in the summer one year and blossoms the following spring. So much food material is required by the blossoms and fruit that the spur is apparently not able to supply an additional amount sufficient to form a fruit bud during the bearing year.

As an apple branch grows, its terminal twigs of the current year bear no spurs. These are developed the second season and, in vigorous trees, blossom and perhaps set fruit during the third season. New spurs are being formed each year and should provide a continuous supply for fruit production so that on vigorous trees of most varieties the biennial bearing of individual spurs is not objectionable as some will bear each year. As many varieties get older a

tendency develops for nearly all of the spurs to blossom in the same year, followed by little or no fruit the next season. In advanced stages of the habit, with such varieties as York Imperial, a heavy crop one year may be followed by no flowers the next season.

This biennial habit is more pronounced on older trees, weaker trees or on trees growing under conditions of a deficient nitrogen supply. Frequently a correction of the fertility problem will correct the habit for a time at least. If all blossom buds are killed early in the spring, a heavy set of fruit may follow in the next year and the trees will be so weakened as to form few fruit buds and the biennial habit is attained at once.

This condition has been corrected experimentally by treatments that prevent fruit production on the major portion of spurs in the heavy crop year and that foster fruit formation in the light or "no" crop year. Annual bearing varieties usually form blossom buds on from 30 to 60 per cent of their spurs each year. The individual spurs do alternate, but there is no one year when there are not sufficient blossoming spurs for a crop if a satisfactory set can be secured.

Fall applications of nitrogen, therefore, have not been recommended for annual bearing trees, particularly for varieties with which it is highly desirable that a large percentage of the blossoms shall set fruit. The beneficial influence of spring applications, made two to four weeks before the bloom, in securing a satisfactory set of fruit is too well known to chance the loss of a good set on any except pronouncedly biennial bearers. The spring application has been recommended for biennial bearers in the "off" year or year of light crops. Dr. H. D. Hooker, one of the earliest investigators of this problem, stated before the Indiana Horticultural Society in 1927 that—"This system (fall applications) is only necessary if you cannot produce regular bearing by any other means. This treatment is only suggested in refractory cases where we have to resort to more elaborate methods." In justice to Dr. Hooker it should be stated that he recommended fall applications together with a special type of pruning the winter following the year of heavy bearing and before the "off" year. This suggestion will be referred to later.

Another advantage claimed for fall applications is that it prevents excessive growth, which shades the fruit, thus pre-

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venting good color and tending to delay maturity. The evidence in support of this claim is not found in published results of experimental work.

Reference was made to the work of Hooker in Missouri. In the spring, summer and fall of 1920 (8) he applied fertilizer to York Imperial trees. He states that the later the nitrogen fertilizer was applied the previous season, the greater was the nitrogen content of the spurs the following March. A severe freeze in the spring of 1921 prevented Dr. Hooker from securing yield records on these trees. He continued the fall applications, however, and in 1922 (9) he reports that some of these trees, treated with nitrate in the fall, bore more fruit in 1922 which would have been an "off" year than the check trees. This treatment supplied the tree with nitrogen just as the spring treatment would, only the nitrogen was stored in the plant over winter instead of being used immediately in new growth. He gives the advantage over spring treatment as that it does not tend to decrease fruit bud formation, but rather appears to favor it. In the same year (10) he summarized his results as follows: "Nitrogen applied about the middle of September is absorbed by the roots and stored in the tree over winter. An application of five pounds per tree applied in the fall of the 'off' year was found to have no direct effect on the set of fruit the following spring but tended to promote carborydrate accumulation in the non-bearing spurs and to favor blossom bud formation."

In the last report of this work published after Dr. Hooker's death (11) he states that by continuing the fertilizer program, it was found that some of the trees that had received either nitrate of soda or sulphate of ammonia in the middle of September of the non-bearing year had become annual bearers, but because of a heavy spring frost in one of the bearing years it was thought that the change from alternate to regular bearing could not be attributed to nitrate treatment alone. Following a heavy crop in 1926 this block of trees was pruned severely during the next winter. During the next "off" year the trees were fertilized moderately in the spring and again in the fall. No pruning was given in 27-28 and no fertilizer in the spring or fall of 1928. In the spring of 1929 nitrogen fertilizers were applied. The yield in this "off" year for the pruned and fertilized trees was 6.7 bushels and for the trees that received no fertilizer 3.5, which would indicate that a combination of pruning after the heavy crop year and spring and fall applications in the "off" year had tended to break the biennial bearing habit.

Hoffman (7) in Virginia applied nitrogen fertilizers in the fall of 1927, to 16-year-old York Imperial trees. He found his average annual growth was longer following fall applications. His yields in the three-year period did not show such definite differences. Where four pounds of fertilizer was applied in the fall the average yield was 207 pounds per tree, as compared to 225 pounds for the same amount applied in the spring. Where two pounds were applied in the fall the average yield was 254 pounds as against 172 pounds where applied in the spring. He remarks that these differences would not be considered significant. Growth and yield taken together favored fall applications. Hoffman also points out the importance of rain precipitation immediately following applications of fertilizer. As a general rule in Virginia, April, June, August and October are good precipitation months. Fertilizers applied during these months gave the better response in the experiments discussed. He concludes that fall applications, with certain split applications, will likely produce better growth and yields in typical Virginia orchards.

Tiedjens (17) working in New Jersey applied several nitrogen-carrying fertilizers on July 19th. The soil was sandy and very dry. Twig growth had stopped. Rain fell five days after the application. No apparent effects could be detected one week after application. Six days after the rain, or eleven days after the application, the leaves of the treated trees exhibited a decidedly green color. Two weeks after the fertilizers were applied, nitrates were found in the tissues of the trees, regardless of the source of nitrogen.

The Maryland station has been investigating this problem for a number of years. In 1925 Schrader and Auchter (15) applied both sodium nitrate and sulphate of ammonia in the fall and spring. Spring applications of either material resulted in greener foliage than full applications. They observed, however, that the fall nitrate resulted in about the same terminal growth and trunk increase as did spring nitrate. They did not record production data. In 1927 they report (16) that spring applications in 1925-26 produced greater spur growth than fall applications in 1924 and 1925.

Hodsoll (6) working in England found that where he made summer and fall applications of natural manures, supplemented with fertilizer, he was enabled to break the biennial bearing habit. In like manner, Cooper (5) in Arkansas reported that on those plots which had received liberal amounts of organic manures the average production was increased over chemical fertilizers alone.

Bradford, (3) working in Michigan, recommended that fertilizers be applied as nearly as can be estimated one to two weeks before blossoming. He points out that the full benefit cannot be realized until the fertilizer has had time to increase growth (first season) increase the number of new spurs (second season) and increase the number of blossoms (third season). Under the conditions reported by Bradford early spring applications materially improved the biennial bearing habit.

Some other investigators have applied fertilizers at different periods and have reported their work. Ralston (14) in Virginia in 1921 reported upon a number of years of experiments in which nitrogen fertilizers had been applied at weekly intervals from March 1 to August 1. He stated that his best results were obtained by applications made before April first. He found that nitrogen might be taken up and utilized by various parts of the trees after length growth ceased thus giving greater functioning ability the succeeding season. However, this response was much less than under earlier treatments. Ralston found that the time of maturity was apparently not modified by the time of treatment. Burrell (4) of Cornell University applied nitrate in midsummer of 1926 and found that these trees bore about three times as much fruit in 1927 as did adjacent untreated trees and these same trees bore about 1½ times as much fruit in 1928 as did check trees. Where nitrate was applied again in the spring of '27 the increase was about 2½ times the check. He states that the effects were considerable, not only the year of application but during the second and third year. He makes the rather interesting observation that the response to this application was greatest in lateral growth, next in yield and least in terminal growth. McCoun, Canadian horticulturist, made the statement that applications about September first had little effect on growth and he concluded that the critical period for applying nigrogen was apparently from the middle of June to the middle of July.

It seems to have been proved that trees are able to absorb nitrogen ap-

plied in the late fall and early winter. Schrader and Auchter (15) found almost equal quantities of nitrogen in the blossoming spurs the following April, whether the trees had been fertilized in the fall or the next spring. Aldrich (1) made applications of nitrogen fertilizer August 15, September 1 and September 15. He found that the total nitrogen in spurs on September 28 was greater where applications had been made on August 15, about the same where applications had been made September 1 and actually less where applications had been made September 15, than the check. This would indicate at least that the earlier applications reached the spurs before winter set in. In some later work Aldrich (2) made applications in November, January and March, and analyzed the roots of these trees. He found that nitrogen increased in the roots of the fertilized trees during the winter months, whether the application was made in November or January. However, none of this nitrogen reached the aerial parts of the trees until growth started. It should be remembered that these applications were made in the winter.

Nightengale (12) found, with one-year pear and blackberry, growing in a nitrogen deficient soil, that they had the ability to assimilate nitrates during the dormant period.

Questions have been raised relative to the effects of fall applications of nitrogen on keeping quality and color of the fruit on the trees at the time of application. Aldrich (1) found that early fall applications made on September 3 and on September 16 had no effect on the fruit color or keeping quality. Applications made on the 19th of August slightly decreased the red color on Stayman and York but increased the color on Rome Beauty. He found a slight decrease in firmness of fruit during storage as compared with the check, when applications were made on August 19. This was the York variety only, and no bad effects were observed on Stayman and Rome. In another year on August 15 application slightly increased the red color of the fruit by September 1 as compared with the check. This fruit was being produced on trees that were deficient in nitrogen. Applications on September 1 and September 15 had no effect on the color of the fruit and none of the applications had any effect on keeping quality. Analyses of the fruit did not show that these applications had increased the nitrogen content of the fruit appreciably.

One factor that is worthy of note is the question of the loss of fertilizers through leaching. Because the fall applications to fruit trees is of comparatively recent origin. Very little definite data is available. Nicholson and Pantin (13) in England ran some tests with different nitrogen carrying fertilizers on an ordinary medium loam soil. They comment that their results bear out the conclusions of experiments at the Rothansted station, that leaching out may occur any time throughout the winter, up to March or early April. The loss of nitrates is directly limited by the amount of drainage and so is indirectly determined by the rainfall and by temperature as it affects the rate of evaporation. These authorities show that over 50 per cent of a normal dressing of the fertilizers used was lost by leaching out during the winter, the loss naturally being greatest with the most soluble fertilizers.

To summarize this conflicting data, we find agreement in recommendations for spring applications to all nitrogen deficient trees except those that have formed a biennial bearing habit and possibly for those trees which, due to excessive growths, are showing poor color and late maturity. There is no evidence that late fall applications will injure the keeping quality and not

much evidence that earlier applications will injure the crop on the trees when the fall application is made. It is quite evident that in some cases, as reported by Hooker for example, the application of fertilizers in the spring and fall of the "off" year will not correct the biennial bearing habit and, as in many other orchard operations, some additional means of breaking up the biennial bearing habit will have to be resorted to.

It takes many years to determine whether a particular practice has modified the biennial bearing habit and in the meantime, in most of these experiments, late spring frosts have prevented determining the point. Fall applications are worth trying in the case of trees which are bearing extremely heavy crops followed by no crop. The practice is one for trial under a given circumstance.

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PRODUCTION COSTS

So few growers keep accurate cost records, and any records are not exactly fitted to the conditions of other growers, but it is always of interest to strike an average with the other fellow. The orcharding conditions of Massachusetts are a little different than those of Maryland, but Mr. Roy E. Moser of Massachusetts State College has reported some average figures before the Fortieth Annual Meeting of the Massachusetts Fruit Growers' Association (1934) that are of interest. Mr. Moser states that the average cost of producing apples in that State in 1932 was $118.38 per acre or 53.4 cents per bushel, not including any package costs nor marketing charges. These figures are based on records of 22 growers with a total of 696 acres of bearing orchard. The average was 222 bushels production per acre.

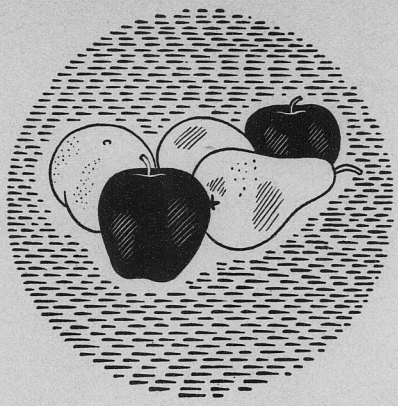
The cost of production up to picking was 32.3 cents per bushel. Picking and hauling the fruit to packing shed, storage or market averaged 13.4 cents per bushel. This is a rather vague figure, and also the packing costs are a little confusing as they consider all methods of packing and grading. This average was 7.6 cents per bushel. An itemized account of costs for the season 1932 is given as follows:

22 Growers	*696 acres*		
	Cost per acre	Cost per bushel cents	% of total
Pruning and Brush Disposal	$ 5.53	2.5	7.7
Spraying and Dusting	24.67	11.1	34.4
Fertilizing	5.42	2.4	7.5
Soil Management	3.17	1.4	4.4
Thinning and Propping	5.30	2.4	7.4
Interest, Taxes, etc.	24.59	11.1	34.2
Miscellaneous	3.12	1.4	4.4
Total	$71.80	32.3	100.0

The most important single item in producing an acre of apples was man labor, 173 hours, averaging $49.73 per acre, or 42% of total cost. An average of 57 hours was used in caring for an acre of apples up to picking time. Picking an acre of apples consumed an average of 95 hours, and grading and packing required 21 hours.

Spraying and dusting cost an average of $24.67 per acre. Half of this cost was for materials, 19% for labor, and 17% for interest, depreciation, repairs and operating costs of the spray outfit. Fourteen per cent of spraying costs was for power to draw the sprayer.

Ten of the growers with 153 bushel average yield per acre spent $87.47 per acre or 57 cents per bushel, while another ten growers had average yields of 312 bushels per acre, costing $126.55 per acre or 41 cents per bushel, to produce. Thus it is seen that average figures are only averages, and cover many types of growers, as well as local conditions.



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